PB-213 301

CONTAINER CORPORATION OF AMERICA BREWTON MILL CONECUH-ESCAMBIA RIVER BASIN STUDY II.

Environmental Protection Agency
Athens, Georgia

November 1971

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CONTAINER CORPORATION OF AMERICA
BREWTON MILL

CONECUH-ESCAMBIA RIVER BASIN

STUDY II

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Environmental Protection Agency
Surveillance and Analysis Division
Region IV
Atlanta, Georgia

November 1971

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INTRODUCTION

This report contains an evaluation of waste treatment at Container Corporation of America's (CCA) Integrated Pulp and Paper Mill located at Brewton, Alabama. The two-week study, conducted during June-July 1971 by the Environmental Protection Agency (EPA), was prompted by 1970 enforcement action. The study was designed to determine the volume of carbonaceous waste generated by increased production, evaluate treatment efficiency and qualify any relative changes in water quality in the Conecuh-Escambia River below CCA's discharge.

This is the third Federal report containing data relative to carbonaceous waste discharges from Container Corporation's Brewton mill. The first study was conducted during September-October 1969 in response to a request from the Governor of Florida to the Federal Water Pollution Control Administration[1/] Southeast Region for technical assistance in evaluating interstate and intrastate pollution in Escambia River and Bay. Results of the study were contained in a report entitled Effect of Pollution on Water Quality, Escambia River and Bay, Florida and served as Federal evidence of pollution in a January 1970 enforcement conference called to consider the matter of pollution of interstate and intrastate water in Escambia River and Bay. The report identified Container Corporation's Brewton Mill as the major point source of carbonaceous wastes discharged into the Conecuh-Escambia River from waste sources in Alabama. Conference recommendation included the removal of 90 percent of the carbonaceous waste generated at the

---

1/ Now the Environmental Protection Agency.

Brewton Mill. At a February 1971 reconvened conference, following a detailed study (August 1970) of waste loads before and after treatment, the conferees recommended that CCA's daily discharge be limited to 4,850 pounds of 5-day Biochemical Oxygen Demand (BOD_5). This progress report contains the status of survey finding with regard to conference recommendations and compares study results with previous findings.

The cooperation and contribution of Container Corporation's mill management during the study are gratefully appreciated. Particular acknowledgements are due to personnel of the mill's Technical Engineering Section.

SUMMARY

Container Corporation of America's integrated pulp and paper mill at Brewton, Alabama has increased average mill production from 900 to 1,050 tons per day. Accompanying this increased production was the addition of a 22-acre aeration basin housing ten-75 horsepower aerators. With the addition of the aeration basin, treatment units in operation at the time of the June 1971 survey included a clarifier, liquid oxygen applicator, oxidation pond, and ponding in six natural lakes. Time of travel for the 17.2 million gallons per day (MGD) of unbleached pulp processing waste routed through this complex of treatment units was approximately 4.8 days. Bleachery waste and woodyard drainage amounting to some 17.3 MGD receive treatment through the system of natural lakes only. The success of the pollution abatement program initiated by CCA is clearly demonstrated by the following comparison of results from the August 1970 and June 1971 studies:

		August 1970	June 1971
1.	Average wastewater volume	32 MGD	34.5 MGD
2.	Average untreated BOD_5 load	44,500 lbs/day	28,200 lbs/day
3.	Average BOD_5 discharge to the Conecuh River	8,500 lbs/day or a population equivalent of 49,900	2,220 lbs/day or a population equivalent of 13,100
4.	Reduction of BOD_5 through facilities including the system of natural lakes	81%	92%

	August 1970	June 1971
5. Average untreated Total Organic Carbon (TOC) load	67,500 lbs/day	50,500 lbs/day
6. Average TOC discharge to the Conecuh River	20,800 lbs/day	15,200 lbs/day
7. Reduction of TOC through treatment facilities including natural lakes	69%	70%
8. Average untreated Chemical Oxygen Demand (COD) load	Not Determined	205,500 lbs/day
9. Reduction of COD through treatment facilities, including natural lakes	Not Determined	80%
10. Average COD discharged to the Conecuh River	Not Determined	40,100 lbs/day
11. Suspended solids reduction through treatment facilities, including system of natural lakes	81%	92%
12. Average non-filterable suspended solids discharged to the Conecuh River	9,800 lbs/day	4,860 lbs/day
13. Average non-filterable volatile solids discharged to the Conecuh River	Not Determined	2,730 lbs/day
14. Volatile solids reduction through treatment facilities, including system of natural lakes	Not Determined	92%
15. Average color in discharge to the Conecuh River	410 Pt-Co units	325 Pt-Co units
16. Range of parameters observed in Conecuh-Escambia River below the CCA discharge (Station Nos. CO-6 & E-9)	D.O.-6.4 to 7.4 mg/l pH-6.1 to 7.2 Temp.-23.5 to 30.0°C Color-40 to 60	6.9 to 7.1 mg/l 6.9 to 7.0 27.7 to 27.9 10

CONCLUSIONS

1. Additional secondary units placed in operation by Container Corporation have resulted in BOD_5 reductions in excess of the 90 percent recommended by the conferees at the February 1971 Escambia River-Bay Enforcement Conference.
2. Through the implementation of additional secondary treatment and improved in-plant controls, Container Corporation has reduced the discharged effluent to less than half the 4,850 pounds per day limit established by conference recommendations.
3. Container Corporation has not complied with the conference recommendation that bleach plant and woodyard wastes be provided secondary treatment.
4. All waste loadings measured at the Brewton Mill were reduced as a result of additional pollution abatement.
5. Woodyard wastes are the largest source of non-filterable suspended and volatile solids discharged to the system of natural lakes.
6. Seventy percent of the color in the wastes flowing into the system of natural lakes are the result of bleach plant discharges.
7. Although corrective measures have improved treatment efficiency and drastically reduced waste discharges, additional reductions can be achieved by:
    - Providing additional treatment to bleach plant and woodyard wastes;
    - Eliminating short circuiting in the aeration basin and oxidation pond.

8. Although Container Corporation has not directed treatment toward color reduction, color in the effluent was less intense than that observed in previous surveys and there was not a noticeable change in color in the Conecuh River above and below the point of CCA's discharge.

9. Except for naturally occurring low pH values in study area tributaries (Murder, Franklin Mill, Little Escambia and Big Escambia Creeks) and elevated BOD_5 in Big Escambia Creek, parameters measured indicated that water in Conecuh-Escambia River tributaries were of relatively good quality.

STUDY AREA

CONTAINER CORPORATION OF AMERICA

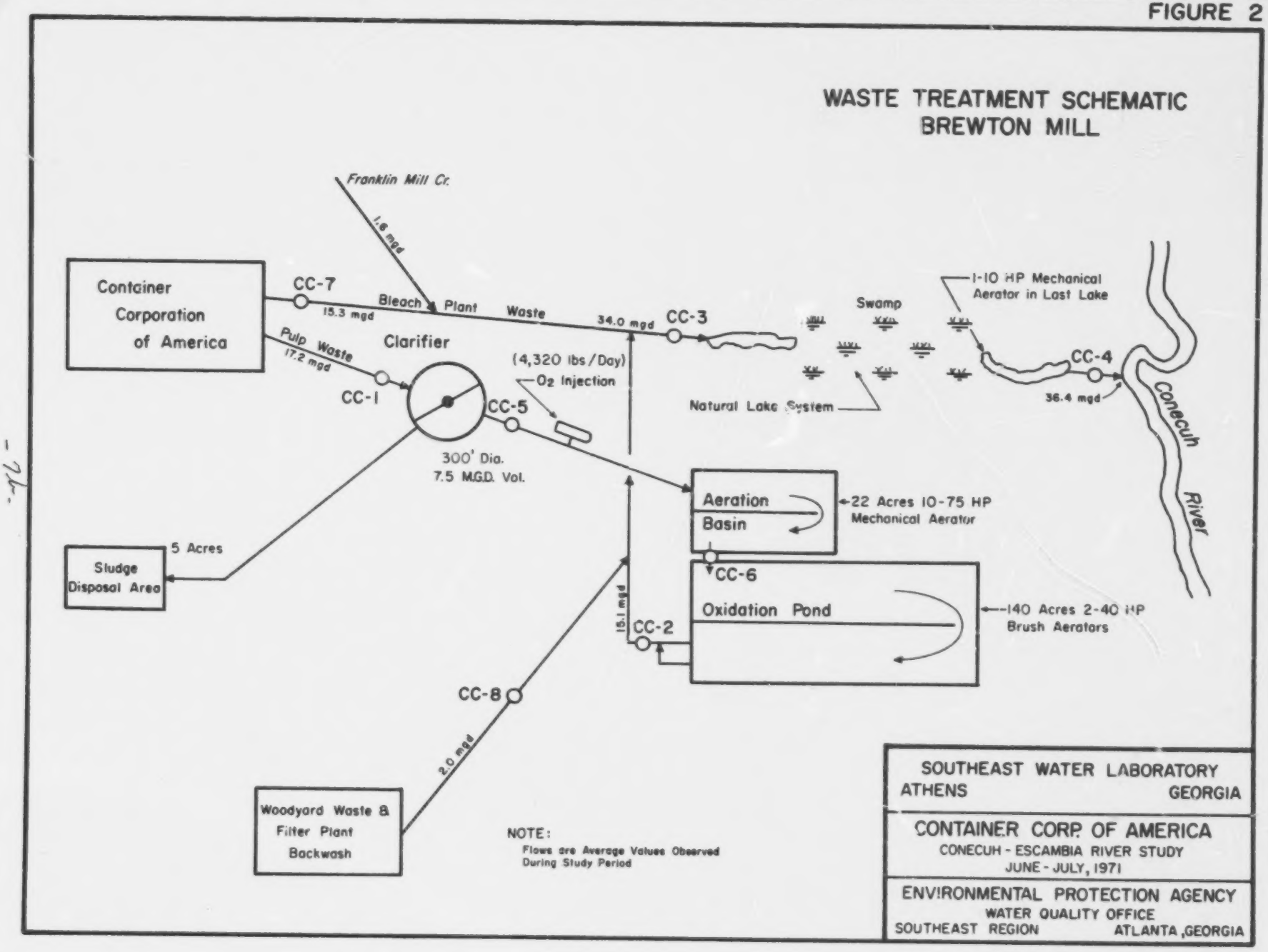
Container Corporation of America's mill at Brewton, Alabama, is located in the Conecuh-Escambia River drainage basin (Figure 1). The integrated Kraft pulp and paper mill processes an average of 1,050 tons per day of pulp, of which 900 tons per day are from wood chips and the remainder bought paper for recycling. Approximately half of the pulp produced is bleached. Expansion plans include increasing wood chip pulping capacity to 1,050 pounds per day in March 1972.

Waste treatment facilities consist of a clarifier, liquid oxygen applicator, aeration basin, oxidation pond and Franklin Mill Creek plus swamp and natural system of 6 lakes. The aeration basin was placed in operation during October 1970; however, operational difficulty delayed continuous operation until January 1971. Figure 2 contains a schematic of waste treatment plus supplimentary information about each treatment unit.

All wastes do not receive the same degree of treatment. Unbleached pulp process wastes are routed through the entire treatment system; however, bleach plant and woodyard wastes are conveyed via Franklin Mill Creek to the swamp and natural lake system. Mill sanitary wastes are routed into the clarifier and serve as the only source of nutrients to the treatment system. Mill wastes are discharged into the Conecuh River at a point approximately 2.7 miles above the Alabama-Florida State line.

Color removal is presently being investigated; however, no additional

FIGURE 2


WASTE TREATMENT SCHEMATIC
BREWTON MILL
Franklin Mill Cr.
1.6 mgd
Container Corporation of America
CC-7
15.3 mgd
Bleach Plant Waste
34.0 mgd
CC-3
Pulp Waste
17.2 mgd
Clarifier
(4,320 lbs/Day) O2 Injection
CC-1
CC-5
300' Dia.
7.5 M.G.D. Vol.
Swamp
1-10 HP Mechanical Aerator in Last Lake
Natural Lake System
CC-4
36.4 mgd
Conecuh River
Aeration Basin
22 Acres 10-75 HP Mechanical Aerator
5 Acres
Sludge Disposal Area
CC-6
Oxidation Pond
140 Acres 2-40 HP Brush Aerators
15.1 mgd
CC-2
CC-8
2.0 mgd
Woodyard Waste & Filter Plant Backwash
NOTE:
Flows are Average Values Observed During Study Period
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
CONTAINER CORP. OF AMERICA
CONECUH - ESCAMBIA RIVER STUDY
JUNE - JULY, 1971
ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

treatment improvements are scheduled for any phase of Container's treatment facility.

CONECUH-ESCAMBIA RIVER BASIN

The Conecuh-Escambia River rises near Union Springs, Alabama, and terminates its south-southwestward journey in Escambia Bay at Pensacola, Florida. The total drainage area of the Conecuh-Escambia River Basin is 4,132 square miles. The Conecuh River and its tributaries in Alabama drain an area of approximately 3,817 square miles.

Streams within the basin flow through wooded areas, are generally shallow with relatively swift currents, and contain the usual natural debris found in waters traversing wooded lands. Major tributaries to the Conecuh-Escambia River in the vicinity of the study area include Murder, Little Escambia, and Big Escambia Creeks. The Conecuh River serves as a source of process water for Container Corporation. Other direct uses of the river and its tributaries, excluding fish and wildlife uses, are for waste disposal. Murder Creek receives industrial wastes from T. R. Miller Company and treated and untreated municipal wastes from Brewton and East Brewton, respectively. Big Escambia Creek also receives effluent from the waste stabilization pond at Flomaton, Alabama. Little Escambia Creek traverses the Pollard Oil Field; however, previous studies have shown the water is of relatively good quality.

Escambia Bay, the recipient of wastes discharged into the Conecuh-Escambia River Basin, has a continuous record of massive fish kills. Although many factors which cause water quality degradation in the bay have been documented, other contributing causes and the triggering

mechanism are still questionable and are undergoing investigation. The study of waste discharges into receiving waters of the Conecuh-Escambia drainage system and water quality in these surface waters near the Alabama-Florida state line are a portion of the ongoing investigations.

WATER QUALITY STANDARDS

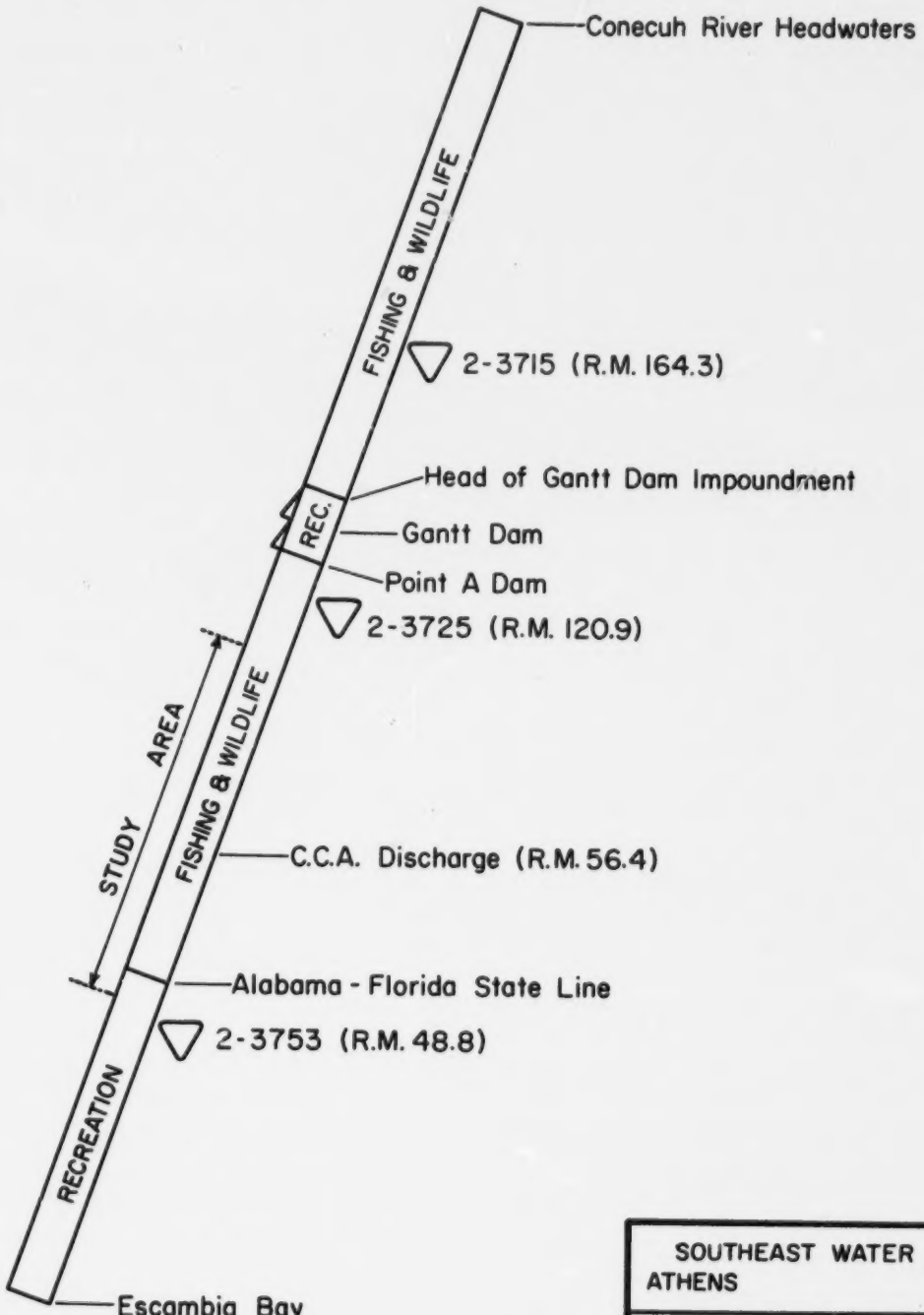
Since the Conecuh-Escambia River originates in Alabama and terminates in Florida, it is classified as an interstate stream. Study area tributaries--Big Escambia and Little Escambia Creeks--are also interstate streams by the same definition. Murder Creek, the other major tributary in the immediate study area, is an intrastate stream since it originates and terminates in Alabama.

The Conecuh-Escambia River is classified for recreation and/or fish and wildlife uses. Figure 3 shows the Conecuh-Escambia River use classifications established by Alabama and Florida. In the Alabama portion of the study area, the Conecuh River, Big Escambia Creek, Little Escambia Creek and Murder Creek are classified for fish and wildlife uses. In the Florida portion of the study area, the Escambia River, Big Escambia Creek and Little Escambia Creek are classified as Class III waters, waters suitable for recreation and the propagation and management of fish and wildlife.

Specific criteria originally adopted by the Alabama Water Improvement Commission has not been accepted by EPA and is presently being revised. The State of Florida has also been notified by EPA that their criteria are no longer acceptable and that revisions will be required. However, the new criteria requirements have not been finalized. Table I contains specific water quality criteria presently adopted by the two states which pertain to the two use classifications.

FIGURE 3

WATER USE CLASSIFICATION
CONECUH - ESCAMBIA RIVER



SCALE 1" = 9.6 MI.

SOUTHEAST WATER LABORATORY
ATHENS GEORGIA

CONTAINER CORP. OF AMERICA
CONECUH - ESCAMBIA RIVER STUDY
JUNE - JULY, 1971

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

Table I

Alabama and Florida Adopted Water Quality Criteria
Conecuh-Escambia River Use Classifications

Item	Specification	
	Alabama	Florida
Temperature	Max. 93°F (10°F Rise)	Insufficient to damage aquatic life, vegetation, or intefere with classified uses.
Dissolved Oxygen	≥4.0 mg/1	≥4.0 mg/1
pH	6.0 to 8.5	6.0 to 8.5
Bacterial	Not Specified	Monthly Avg. ≤1,000/100 Daily Value ≤2,400/100
Turbidity	Not Specified	≤50 JTU above background
Toxic Susbstances	≤1/10 48 hours TLM	Free from substances toxic or harmful to humans, animals, or aquatic life
Taste, odor and color producing substances	No amount that will injure fish and aquatic life, impair marketability palatability or unreasonably affect the aesthetic use value	No amount sufficient create a nuisance

Study Program

At the second session of the February 1971 Escambia Bay Enforcement Conference, recommendations required Container Corporation to reduce its BOD_5 by 90 percent and established a maximum effluent waste load of 4,850 pounds per day. Also included in the recommendation was an evaluation of increased pulping capacity on BOD_5 discharges.

An evaluation of Container Corporation's waste abatement facility and the relative effect of the waste discharge upon water quality in the Conecuh-Escambia River was conducted during the weeks of June 20 and 27, 1971. The mill survey was designed to determine the volume of wastes generated by increased product production and to determine the effectiveness of the improvement in treatment following the addition of a 22-acre aeration basin after the August 1970 field study. Eight influent and effluent sampling sites located at each treatment unit were sampled to determine treatment effect on BOD_5, TOC, COD, color, solids, pH and temperature. Stream samples were collected from 7 sampling locations within the immediate basin area and analysed for parameters that would reflect any relative changes in water quality below the mill discharge. Both in-plant and stream sampling locations are shown in Table II. Other chemical sampling included sampling of the oxidation pond for dissolved oxygen fluctations and bleachery waste for polychlorinated biphenols (PCB's) content.

Dye tracer studies were conducted to demonstrate time of travel throughout the entire treatment system. Water quality data was supplemented by flow measurements at both in-plant and stream sampling stations.

Table II

Sampling Station Number and Location
Brewton Paper Mill and
Conecuh-Escambia River System

In-Plant Stations

CC-1 Clarifier influent

CC-5 Clarifier effluent

CC-6 Aeration basin discharge

CC-2 Oxidation pond outlet

CC-7 Bleach plant waste at sewer line discharge

CC-8 Woodyard waste prior to dilution with oxidation pond discharge

CC-3 Franklin Mill Creek spillway below junction of all mill wastes

CC-4 Brewton Lake discharge 200 yards upstream from Conecuh River (RM 56.4)

Conecuh-Escambia River System Stations

CO-5 Conecuh River at Alabama Highway 41 bridge (Edwards Bridge) near Brewton, Alabama (RM 67.10).

CO-6 Conecuh River at Pollard boat landing located approximately two miles downstream from the Brewton Lake discharge.

M-11 Murder Creek at Container Corporation's process water intake located near the mouth of Murder Creek.

LE-7 Little Escambia Creek at U. S. Highway 31 bridge near Pollard, Alabama.

BE-8 Big Escambia Creek at Escambia County road near Century, Florida.

E-9 Escambia River at Florida Highway 4 near Century, Florida (RM 48.80).

FM-10 Franklin Mill Creek at U. S. Highway 31 bridge at Brewton, Alabama.

STUDY FINDINGS

GENERAL DISCUSSION

Climatologic conditions within the Brewton area were seasonal and almost constant. Average high temperatures were 95.9°F, 2 degrees above normal.[1/] Precipitation was almost nil within the Brewton area except for a few scattered showers the latter part of the second week. Flows in Murder Creek and the Conecuh-Escambia River showed increases the second week from precipitation north of Brewton.

The Escambia River at Century, Florida has a drainage area of 3,817 square miles and a 37-year average daily discharge of 5,952 cubic feet per second (cfs) with extremes from 596 cfs to 77,200 cfs. The seven-day, 10-year low flow is 785 cfs. The U. S. Geological Survey gaging station at Century, Florida reports the average flow in the Escambia River at Century for the two-week study period was 2,560 cfs. Little Escambia, Franklin Mill and Murder Creeks were gaged and referenced with tape downs to establish rating curves. Big Escambia Creek was not gaged because of water depth. Existing flumes and weirs were used for in-plant flow measurements at sampling stations CC-1, CC-5, CC-6, and CC-7. The discharge at station CC-8 was formulated from water treatment plant usage records. The flow at Station CC-2 was calibrated and continuously measured with Stevens recorders. The Brewton Lake discharge (CC-4) was stream gaged and assumed to be constant because of physical conditions.

1/ U. S. Department of Commerce, Climatological Data, Alabama, June 1971, Volume 77 No. 6.

CONTAINER CORPORATION'S TREATMENT EVALUATION

Comparison of 1970 and 1971 Study Results

With the addition of a 22-acre aeration basin, the average BOD_5 removal efficiency of the treatment system at the Brewton Mill improved from 81 percent to 92 percent.[1/] Corresponding TOC reductions showed no significant improvement -- 69 percent removal for 1970 compared to 70 percent removal this year. The TOC analyses added to the 1971 study indicated an overall removal rate of 80 percent. Color in the effluent was 85 units lower than that observed during the 1970 survey. The step reduction in these parameters through the treatment system are summarized in Table III, and Table IV contains a summary of waste treatment loads. All water quality data are presented in Appendix E.

Physical and Chemical Data

During the study period, the volume of waste in the mill effluent was 34.5 million gallons per day (MGD). Waste flow from the bleach plant averaged 15.3 MGD and pulp processing waste averaged 17.2 MGD. The flow from the woodyard operation, including water plant filter backwash wastes, average approximately 2 MGD. Although not a product of mill operation, an average flow of approximatley 1.6 MGD in Franklin Mill Creek flows through the swamp and natural lake system. Figure 2 contains average flows observed throughout the treatment system and depicts the effects of seepage and evaporation on the treatment system.

1/ All comparisons are between CCA field studies of August 1970 and June 1971.

Table III

Waste Treatment Data Summary
Container Corporation of America-Brewton Mill
(June-July 1971)

Station No. & Location	Range	Flow (MGD)	Water Temp. (°C)	pH	Color (PT-CO Units)	BOD_5 (mg/l)	TOC (mg/l)	COD (mg/l)	Solids-Non-Filterable	
									Suspended	Volatile
CC-1	Max.	--	45.0	9.7	700	270	400	2,670	684	452
Clarifier	Min.	--	40.5	7.3	125	80	125	547	168	102
influent	Mean	17.2	43.7	8.6	392	131	205	1,070	319	204
CC-5	Max.	--	44.0	9.4	600	130	165	507	160	88
Clarifier	Min.	--	39.5	7.1	140	62	60	297	36	29
effluent	Mean	17.2	43.2	8.6	340	98	98	380	88	49
CC-6	Max.	--	36.0	7.6	200	31	79	233	65	37
Aeration	Min.	--	33.0	6.4	120	17	44	130	8	2
basin effluent	Mean	16.7	35.0	7.2	172	24	60	180	30	17
CC-2	Max.	16.1	29.5	8.5	200	13	49	148	104	23
Oxidation	Min.	14.0	26.5	5.4	120	8	33	107	10	4
pond effluent	Mean	15.0	28.6	7.5	158	10	40	129	46	10
CC-7	Max.	--	45.5	3.8	600	84	220	435	54	42
Bleach	Min.	--	41.5	2.9	400	34	75	212	8	2
plant effluent	Mean	15.3	43.5	3.2	500	69	156	369	26	18
CC-8	Max.	--	32.0	7.3	400	44	120	526	884	248
Woodyard	Min.	--	26.5	5.7	200	24	32	192	196	72
effluent	Mean	2.0	29.4	6.8	291	37	69	326	578	169
CC-3	Max.	35.0	32.0	6.7	600	45	77	227	68	28
Franklin	Min.	32.9	28.5	6.0	200	24	50	143	16	4
Mill Creek @ spillway	Mean	34.0	30.6	6.3	299	31	64	198	39	15
CC-4	Max.	--	28.0	7.5	600	10	57	152	27	14
Brewton	Min.	--	19.5	7.0	200	5	44	60	6	4
Lake effluent	Mean	36.4	24.6	7.2	325	7	50	132	16	9

Table IV

Summary Waste Treatment Loads (lbs/day)
Container Corporation of America - Brewton Mill
(June-July 1971)

Station No. & Location	BOD*	TOC*	COD*	Solids, Non-Filterable Suspended*	Solids, Non-Filterable Volatile*
CC-1 Clarifier influent	18,800	29,400	153,000	45,800	29,300
CC-5 Clarifier effluent	14,100	14,100	54,500	12,600	7,030
CC-6 Aeration basin effluent	3,310	3,360	25,100	4,180	2,370
CC-2 Oxidation pond effluent	1,310	5,000	16,200	5,760	1,250
CC-7 Bleach plant effluent	8,750	19,900	47,100	3,320	2,300
CC-8 Woodyard effluent	620	1,150	5,440	9,640	2,820
CC-3 Franklin Mill Creek @ spillway	8,900	18,100	56,100	11,100	4,250
CC-4 Brewton Lake effluent	2,220	15,200	40,100	4,860	2,730

* Denotes mean values.

Although average production was 150 tons per day higher than last year's 900 tons per day, the average untreated BOD_5 load generated decreased from 44,500 pounds per day to 28,200 pounds per day. Reduction by in-plant controls, coupled with a treatment reduction of 92 percent, produced an average effluent BOD_5 of 2,220 pounds per day or a discharge equivalent to that from a human population of 13,100.[1/] A BOD_5 reduction of 25 and 83 percent were noted in the pulp process waste routed through the clarifier and aeration basin, respectively. The average BOD_5 load in the oxidation pond effluent showed a discharge of 1,310 pounds per day, an overall reduction of 93 percent. Average BOD_5 reductions throughout the treatment system are shown in figure 4.

The untreated TOC load generated by the mill was down from last year's 67,500 pounds per day to 50,500 pounds per day. Neither this reduction nor the addition of the aeration basin noticeably affect the TOC removal rate. An average TOC load of 15,200 pounds per day was discharged to the Conecuh River (Figure 5). This represents a 5,600 pound per day decrease from 1970. It should be noted that only the pulp wastes are conveyed to the aeration basin, whereas the bleach plant wastes are discharged untreated to the system of natural lakes. The average daily TOC discharge from the bleach plant is 19,900 pounds. Results from the 1970 study showed that the TOC in the pulp processing wastes received an 84 percent reduction in the clarifier and oxidation pond. With the addition of the aeration basin to this treatment, the TOC reduction was 83 percent.

Brewton Mill BOD/TOC regression analyses expressed as percent

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1/ One population equivalent = 0.17 pounds per capita per day.

FIGURE 4

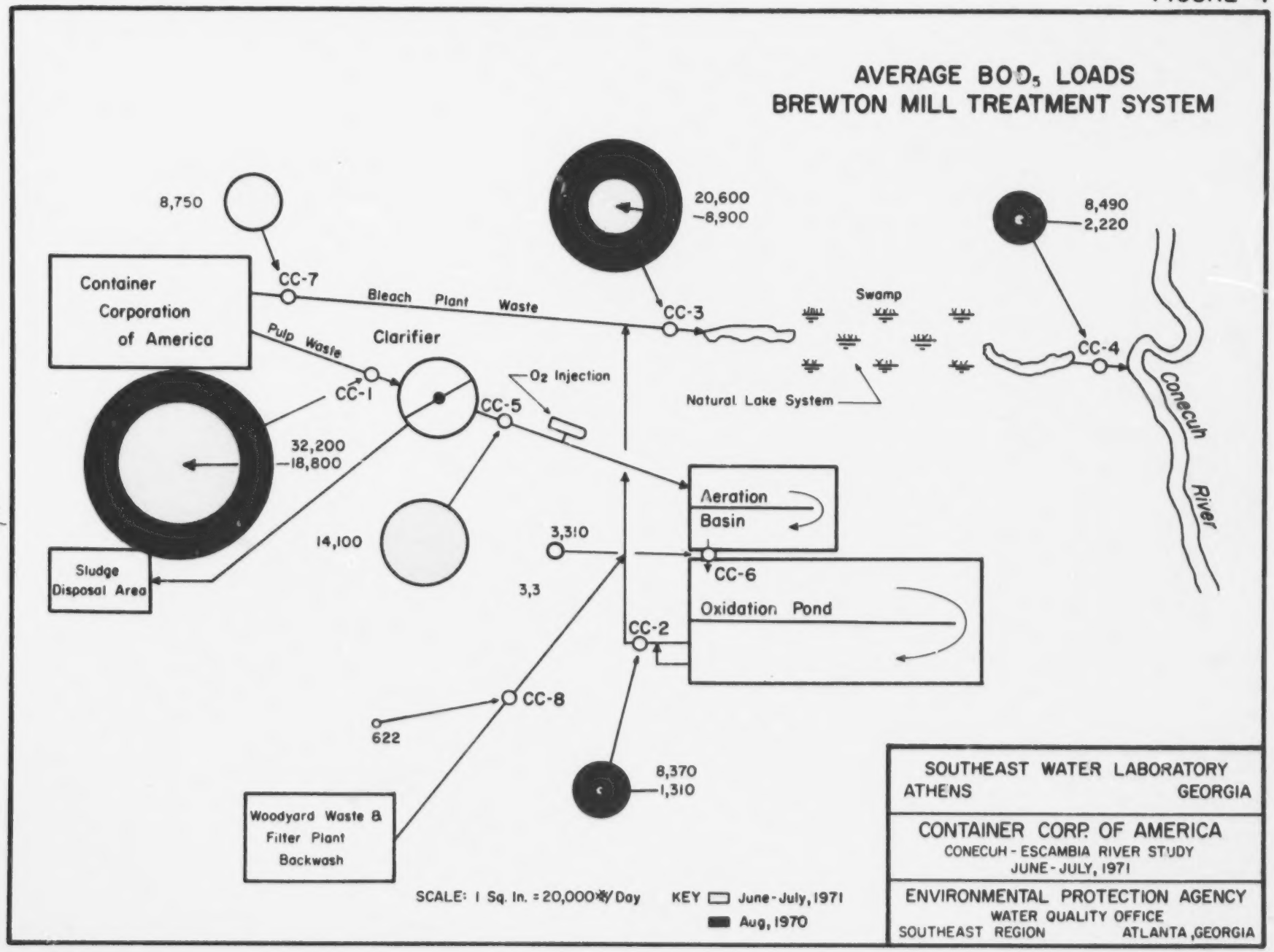
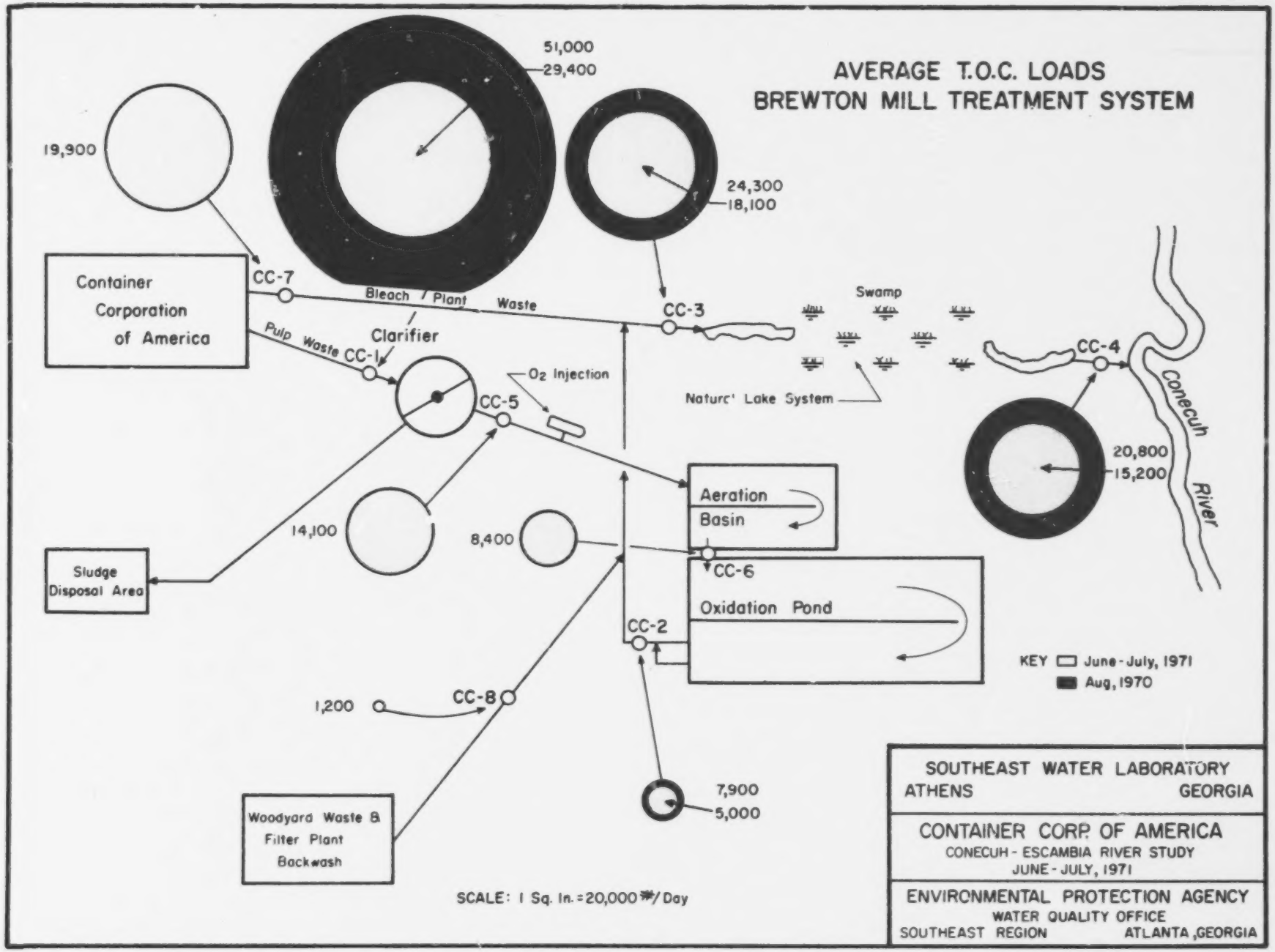

AVERAGE BOD5 LOADS
BREWTON MILL TREATMENT SYSTEM
8,750
CC-7
Container Corporation of America
Bleach Plant Waste
Pulp Waste
Clarifier
CC-1
CC-5
O2 Injection
32,200
18,800
Sludge Disposal Area
14,100
20,600
8,900
CC-3
Swamp
Natural Lake System
8,490
2,220
CC-4
Conecuh River
Aeration Basin
3,310
CC-6
Oxidation Pond
3,3
CC-2
CC-8
622
8,370
1,310
Woodyard Waste & Filter Plant Backwash
SCALE: 1 Sq. In. = 20,000#/Day
KEY June-July, 1971
Aug, 1970
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
CONTAINER CORP. OF AMERICA
CONECUH - ESCAMBIA RIVER STUDY
JUNE - JULY, 1971
ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

FIGURE 5


AVERAGE T.O.C. LOADS
BREWTON MILL TREATMENT SYSTEM
51,000
29,400
24,300
18,100
19,900
Container Corporation of America
CC-7
Bleach Plant Waste
CC-3
Swamp
Pulp Waste
CC-1
Clarifier
O2 Injection
CC-5
Nature' Lake System
CC-4
Conecuh River
20,800
15,200
Aeration Basin
14,100
8,400
Sludge Disposal Area
CC-6
Oxidation Pond
CC-2
KEY June-July, 1971
Aug, 1970
1,200
CC-8
7,900
5,000
Woodyard Waste & Filter Plant Backwash
SCALE: 1 Sq. In. = 20,000 #/Day
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
CONTAINER CORP. OF AMERICA
CONECUH - ESCAMBIA RIVER STUDY
JUNE - JULY, 1971
ENVIRONMENTAL PROTECTION AGENCY
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SOUTHEAST REGION ATLANTA, GEORGIA

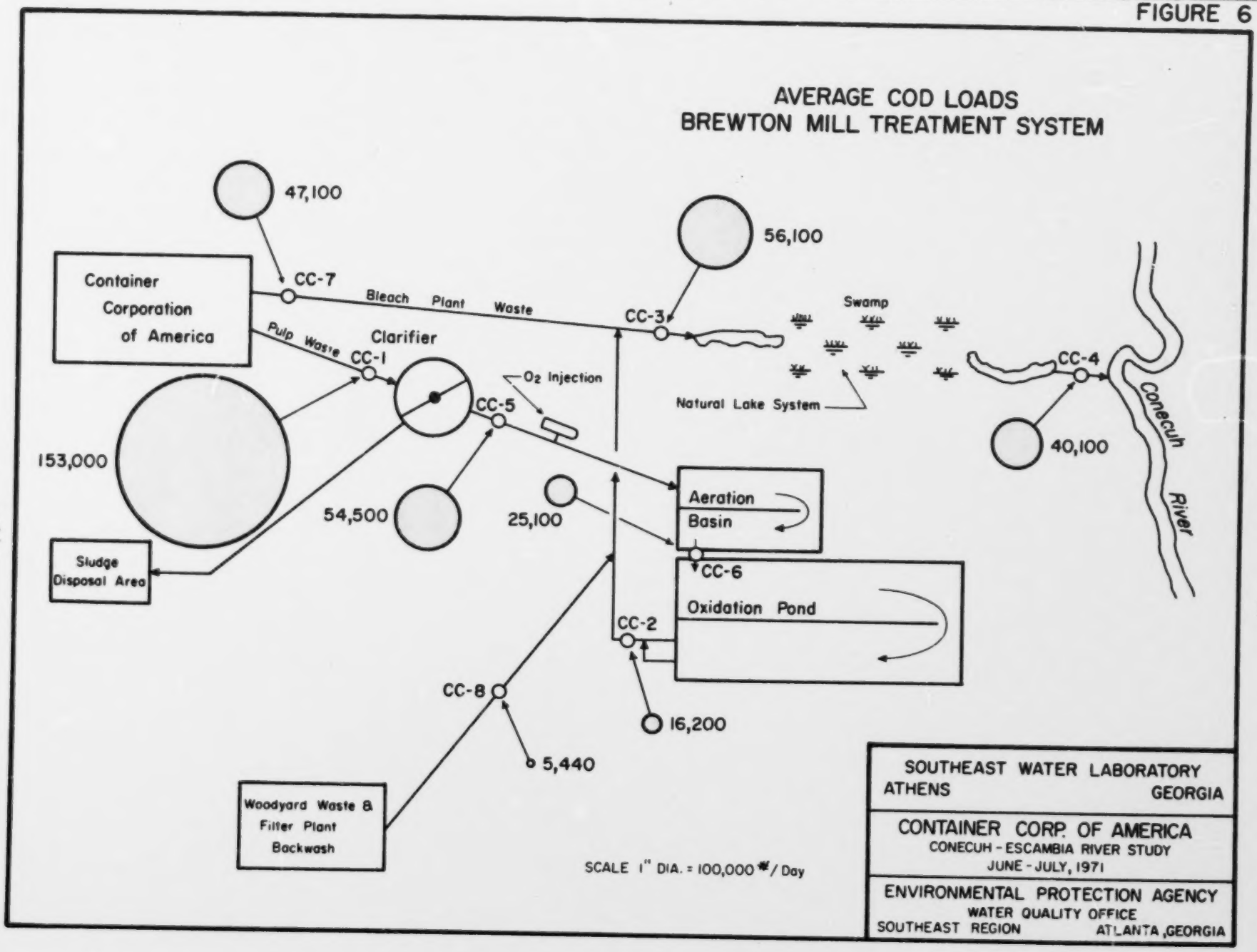
-141-

BOD removed showed approximately a 1 to 1 removal rate for TOC as a function of BOD between the 25 percent to 75 percent removal range. These were computed from the August 1970 data. Above 75 percent removal, the inherent differences in TOC and BOD are very relevant and no relationship is seemingly available. For example, at Brewton Lake discharge, after approximately 5 days retention, the BOD/TOC regression line shows a constant slope which indicates no change in TOC for varying BOD concentrations. This same relationship was apparent with the addition of the aeration basin.

Although the 1970 study did not include a COD analysis, samples collected during the 1971 study showed that the daily waste generated contained 205,500 pounds of COD. The daily effluent from pulp processing, bleach plant and woodyard contained 153,000, 47,100, and 5,440 pounds of COD, respectively. The overall COD reduction through the treatment system was 80 percent. The COD reduction through the aeration basin and oxidation pond were 84 percent and 89 percent, respectively. The system of natural lakes removes about 29 percent of the COD in the influent; however, the daily discharge into the Conecuh River still contains 40,100 pounds. Figure 6 shows the average COD reduction throughout the treatment system.

The non-filterable suspended solids removal at the Brewton Mill was 93 percent. The average daily discharge to the Conecuh River contained 4,860 pounds of suspended solids, a 10,270 pound per day reduction over the 1970 load. The raw pulp process wastes at the clarifier inlet are the largest source of suspended solids at 45,800 pounds per day. The suspended solids load in the effluent from the clarifier was 12,600 pound per day, a removal of 72 percent. Treatment through the aeration basin and oxidation pond results in a overall reduction

FIGURE 6


AVERAGE COD LOADS
BREWTON MILL TREATMENT SYSTEM
47,100
56,100
Container Corporation of America
CC-7
Bleach Plant Waste
CC-3
Swamp
Pulp Waste
Clarifier
CC-1
O2 Injection
CC-4
CC-5
Natural Lake System
Conecuh River
153,000
40,100
54,500
25,100
Aeration Basin
Sludge Disposal Area
CC-6
Oxidation Pond
CC-2
CC-8
16,200
5,440
Woodyard Waste & Filter Plant Backwash
SCALE 1" DIA. = 100,000 #/ Day
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
CONTAINER CORP. OF AMERICA
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of 88 percent. The oxidation pond effluent contained a suspended solids load of 5,760 pounds per day. The daily oxidation pond effluent contains 1,580 pounds more of suspended solids than the aeration basin effluent. Plankton-algal growth and a seasonal increase in insect larvae and insects probably account for this increased load. The 9,640 pounds per day of suspended solids from the woodyard and filter plant backwash are the largest single source of solids discharged to the system of natural lakes. Prior removal of these solids would appreciably reduce the suspended solids load discharged to the Conecuh River. Bleach plant waste contained only 3,320 pound of suspended solids. Figure 7 illustrates the average suspended solids load for each sampling site in the treatment process.

The mill discharge to the Conecuh River contains 2,730 pounds per day of non-filterable volatile solids. This load represents a 92 percent reduction in the total volatile solids produced from the three waste sources. The daily discharge from pulp processing, bleach plant and woodyard operation contained 29,300, 2,300 and 2,830 pounds of volitable solids, respectively. Average volatile solids in the pulp processing waste was reduced to 1,250 pound per day, a 96 percent reduction, by treatment through the man-made system. Average volatile solids loads for each sampling site are contained in Table III.

There is no direct method for removing color employed at the Brewton Mill. Figure 8 illustrates the color concentrations at each in-plant sampling station. There was a slight increase in color as the wastes flowed through the system of natural lakes. At the Franklin Mill Creek sampling site (CC-3), where all wastes have mixed, the color was 299 units, of which 70 percent was from the untreated bleach plant wastes. The average color concentration in the discharge to the Conecuh River

FIGURE 7

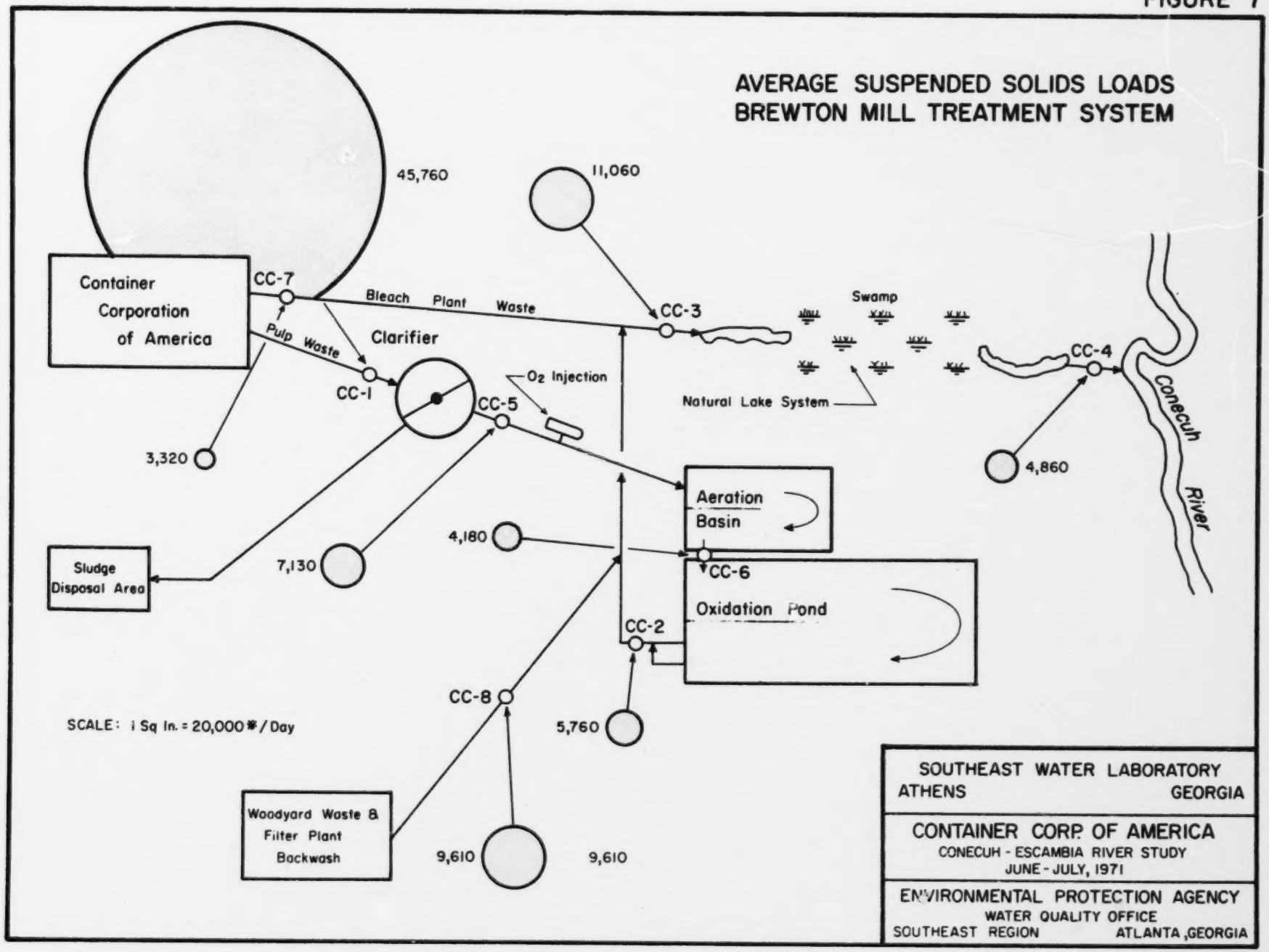
AVERAGE SUSPENDED SOLIDS LOADS
BREWTON MILL TREATMENT SYSTEM
45,760
11,060
Container Corporation of America
CC-7
Bleach Plant Waste
CC-3
Swamp
Pulp Waste
Clarifier
CC-4
CC-1
O2 Injection
CC-5
Natural Lake System
Conecuh River
3,320
4,860
Aeration Basin
4,180
Sludge Disposal Area
7,130
CC-6
Oxidation Pond
CC-2
CC-8
SCALE: 1 Sq In. = 20,000 #/Day
5,760
Woodyard Waste & Filter Plant Backwash
9,610
9,610
SOUTHEAST WATER LABORATORY
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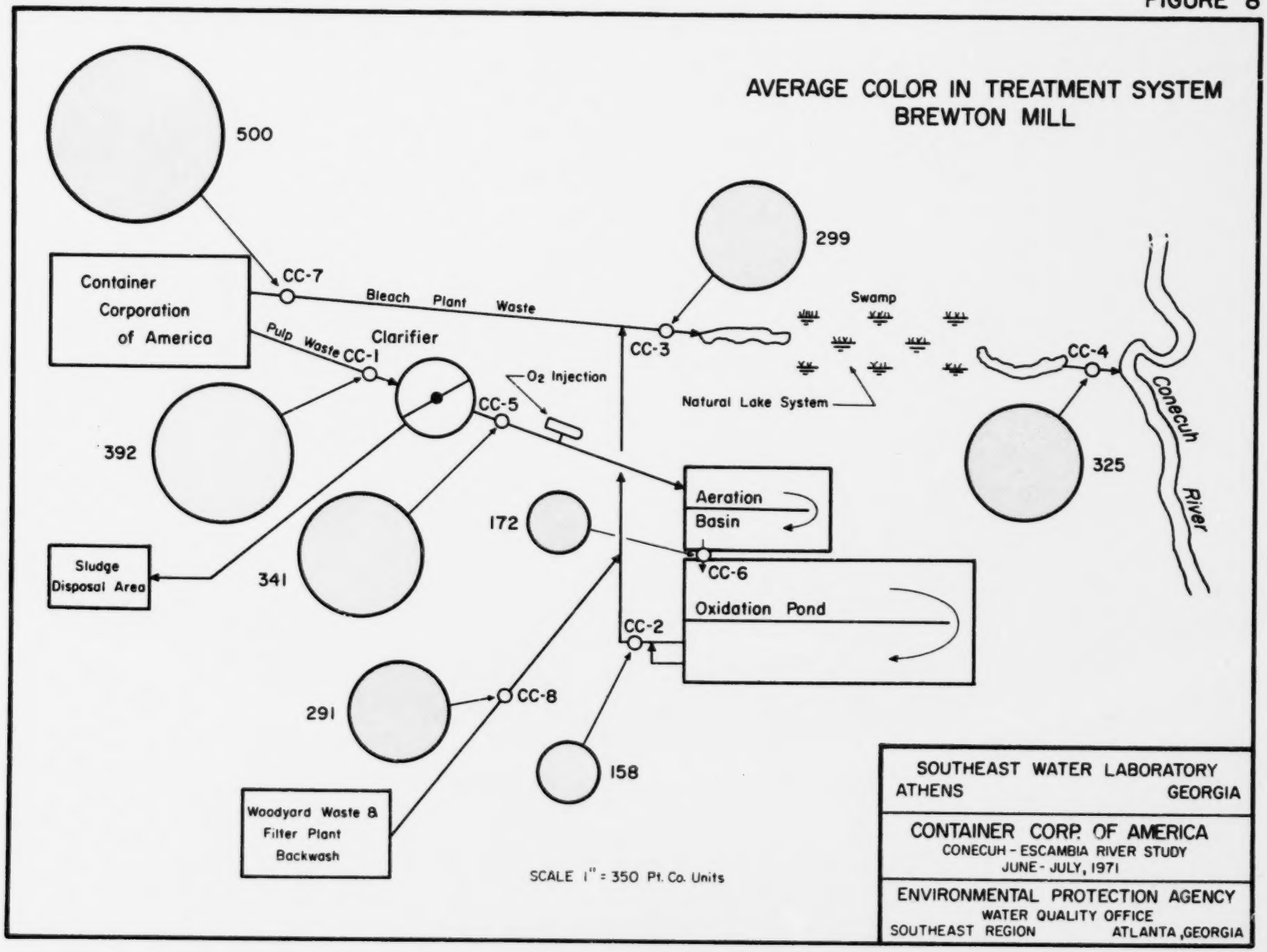
FIGURE 8


AVERAGE COLOR IN TREATMENT SYSTEM
BREWTON MILL
500
299
Container Corporation of America
CC-7
Bleach Plant Waste
Pulp Waste
CC-1
Clarifier
CC-3
Swamp
CC-4
O2 Injection
CC-5
Natural Lake System
Conecuh River
392
325
Aeration Basin
172
Sludge Disposal Area
341
CC-6
Oxidation Pond
CC-2
291
CC-8
158
Woodyard Waste & Filter Plant Backwash
SCALE 1" = 350 Pt. Co. Units
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
CONTAINER CORP. OF AMERICA
CONECUH - ESCAMBIA RIVER STUDY
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was 325 units.

Samples collected from the bleach plant at Brewton Lake were analyzed for polychlorinated biphenols (PCB's); however, PCB's were not detected in the effluent.

Special Studies

A diurnal study to show dissolved oxygen fluctuations in the 140-acre oxidation pond was performed June 23 and 24. Figure 9 exhibits the extremely high dissolved oxygen concentrations in the shallow pond. A large plankton-algal population existed which produced dissolved oxygen concentrations in the pond effluent near or above the saturation point at all times. Dissolved oxygen in surface samples varied from 2.8 to 18.0 mg/l, while dissolved oxygen in bottom samples ranged from 3.0 to 12.0 mg/l.

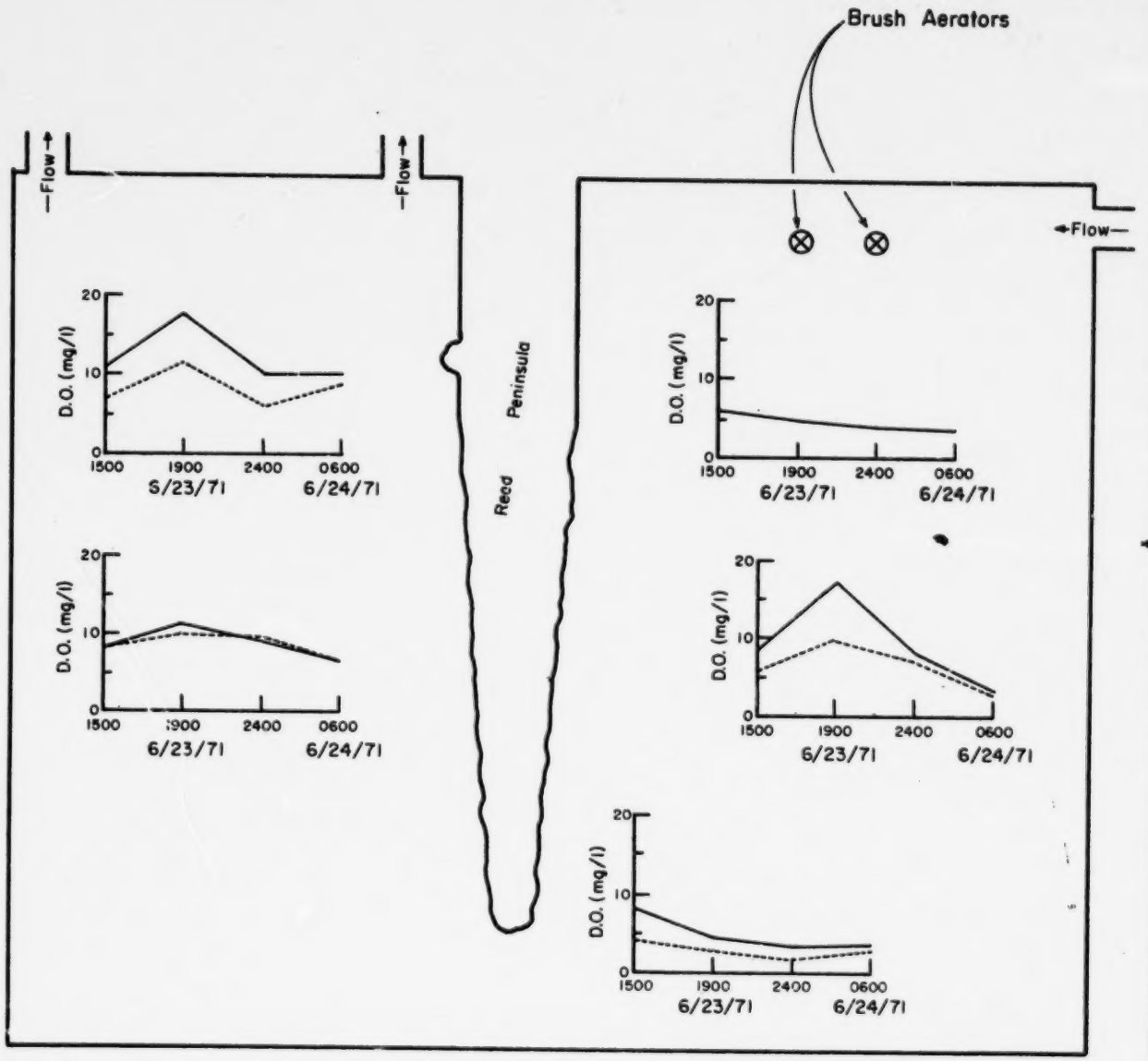
Dye studies were used to demonstrate the retention time of pulp process wastes in the aeration basin and oxidation pond and the time of travel of wastes through the swamp and natural system of lakes. Time of travel studies of the flow of bleach plant wastes to the junction of other wastes were also made.

Dye study procedures are included in Appendix B. The dye studies showed approximate travel times of:

- 26 minutes from the oxygen application nozzle to the aeration basin inlet;
- 6 hours 34 minutes from the aeration basin inlet to outlet;
- 48 hours from oxidation pond inlet to outlet;
- 58 1/2 hours from the bleach plant sewer discharge (cc.7) to the Conecuh River; and
- 4 3/5 days from the clarifier outlet to the Conecuh River.

FIGURE 9

DISSOLVED OXYGEN DIURNAL
BREWTON MILL OXIDATION POND



KEY
— Surface
---- Bottom

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CONTAINER CORP. OF AMERICA CONECUH - ESCAMBIA RIVER STUDY JUNE - JULY, 1971
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The travel times indicated for dye passage in the aeration basin and oxidation pond were measured from the time of injection until the first dye trace was detected. The remaining travel times were computed from dye peak to dye peak after an instantaneous dye dump. The 4.6 days travel time from the clarifier outlet to the Conecuh River includes an estimated 2-hour travel time from the oxidation pond outlet to the Franklin Mill Creek spillway, station CC-3. This estimate was based on several stream velocity measurements and related travel time studies.

Figure 10 shows the visually observed movement of dye through the aeration basin and the apparent short circuiting. However, there is still enough retention time in the aeration basin to remove 77 percent, 54 percent and 41 percent of the incoming BOD, COD and TOC, respectively. Improvement of these reduction rates is a function of time which depends on increasing the aeration basin's retention time. Two possible remedies are a simple baffle system and re-alignment of the aerators using a better rotation scheme to improve mixing.

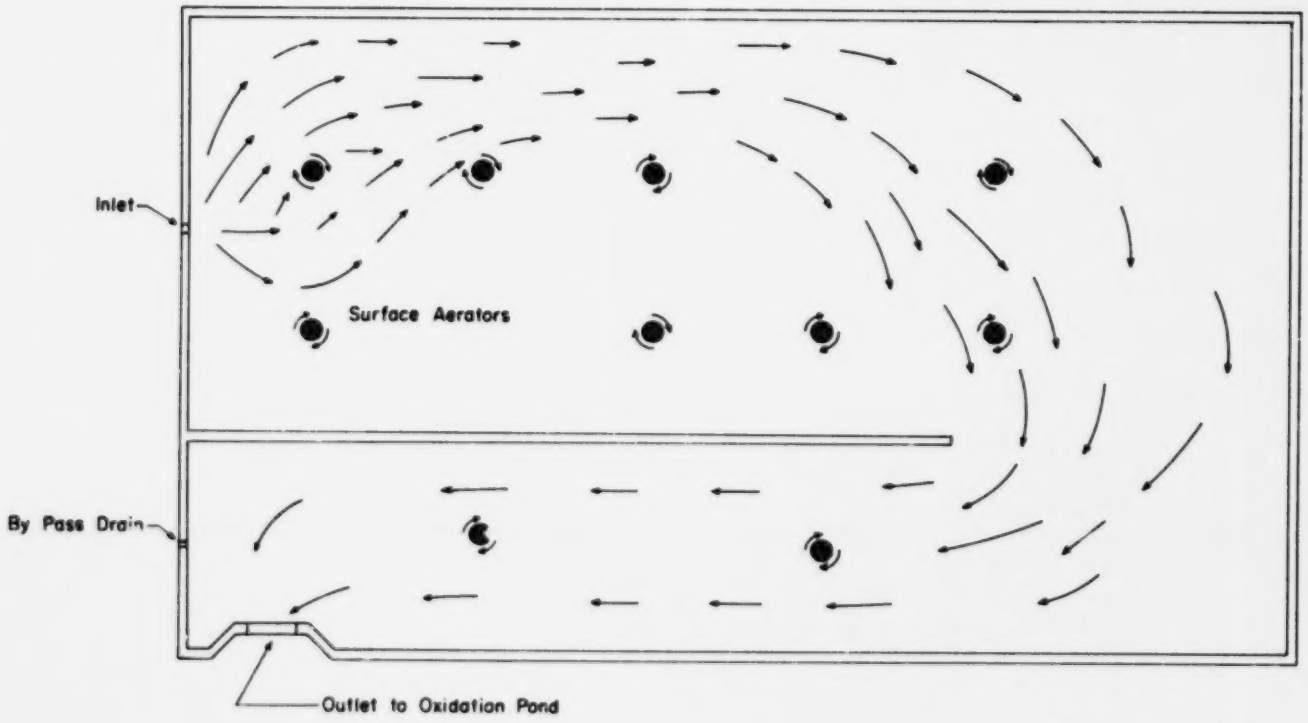
The travel time through the system of natural lakes to the Conecuh River was 53 hours. The 4.9 mile, 6-lake system is severly channeled. The 6 lakes ranging in size from 1.9 acres to 18.6 acres cover an area of 44.6 acres and have a total volume of 129.4 million gallons.

CONECUH-ESCAMBIA RIVER BASIN WATER QUALITY

The water quality parameters analysed on water samples collected from the Conecuh-Escambia River did not show a standard violation. Although flow in the Escambia River at Century was less than half the

FIGURE 10

DYE CIRCULATION
BREWTON MILL AERATION BASIN



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37 year average, there was no appreciable difference in dissolved oxygen, temperature, pH and color at river sampling stations above and below the Brewton Mill discharge. The minimum dissolved oxygen observed in the river was 6.8 mg/l at both Pollard landing and Florida Highway 4 bridge near Century. The minimum dissolved oxygen at Edwards Bridge, assumed to exemplify background conditions, was 7.1 mg/l. The temperature in the river varied from 25° to 30° Centigrade and the pH ranged from 6.5 to 7.2. Color held steady at 10 units at all river sampling stations. There was a noticeable increase in BOD_5 in the Escambia River near Century; however, elevated BOD_5s were also noted in Big Escambia Creek which affects the BOD_5 at Century. Average BOD_5 in the Escambia River at Century was 1.9 mg/l while BOD_5s in the Conecuh River above and below CCA's discharge were 0.8 and 1.0 mg/l, respectively. Total organic carbon, COD, suspended solids and volatile solids ranged from 2 to 10 mg/l, 4.0 to 22.4 mg/l, 2 to 36 mg/l, and zero to 8 mg/l, respectively.

Except for low pH values observed in all tributaries sampled and the elevated BOD_5 in Big Escambia Creek, parameters measured indicate relatively good water quality in the Conecuh-Escambia River tributaries (Table V). The pH in Big Escambia, Little Escambia and Murder Creeks were lower than the limit specified in adopted criteria. Minimum pH values of 5.3, 5.4, 5.5, and 5.6 were observed in Murder, Little Escambia, Franklin Mill and Big Escambia Creeks, respectively. Previous survey sampling of these tributaries above any known point source discharges have also revealed low pH values, and these low values are assumed to be normal for stream in this general area. Although Murder

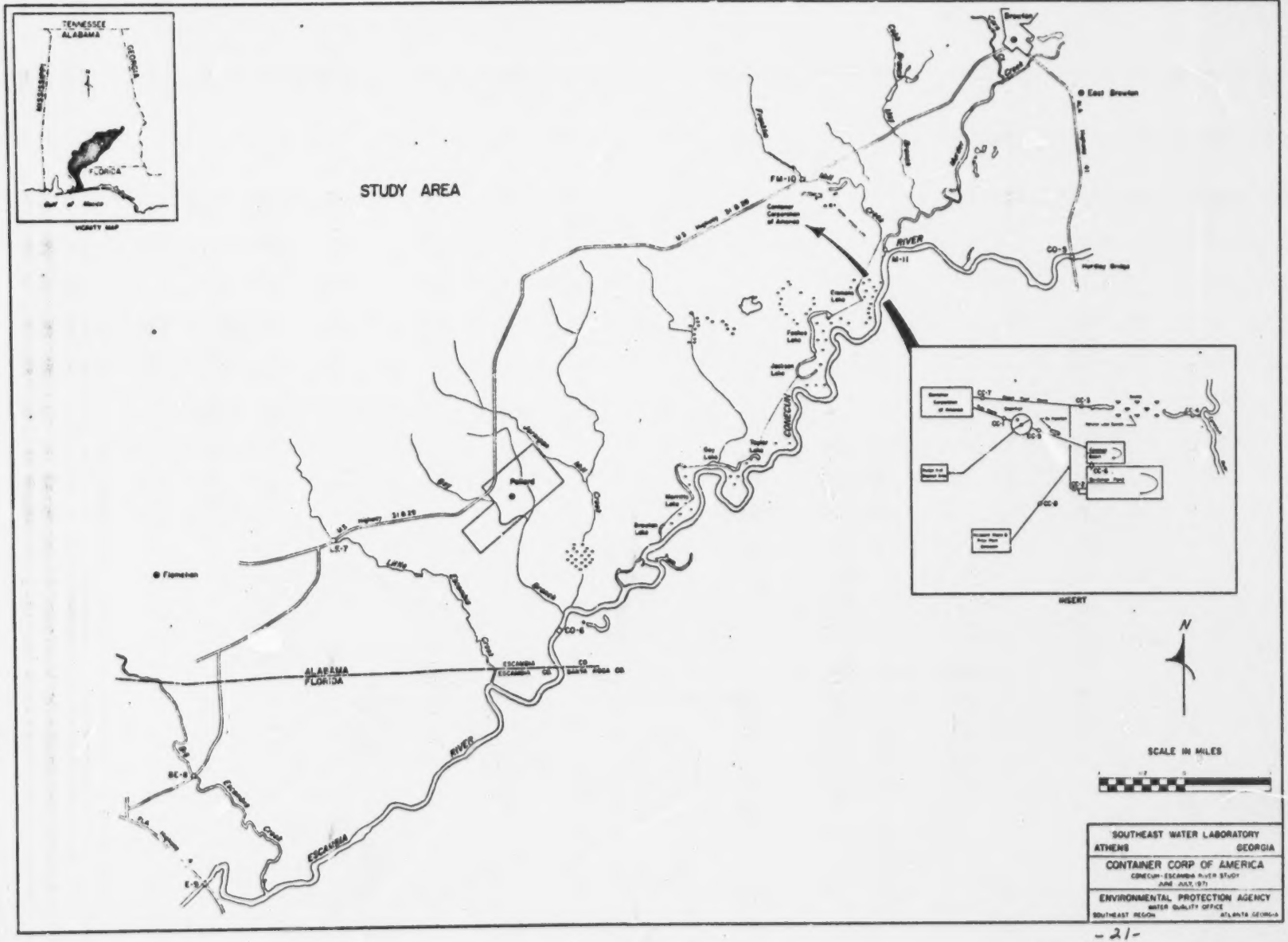
Table V

Water Quality Data Summary
Conecuh-Escambia River System
(June-July 1971)

Station No. & Location	Range	Water Temperature	Dissolved Oxygen	pH	Color (PT-Counts)	BOD_5 (mg/l)	COD (mg/l)	TOC (mg/l)	Solids Non-Filterable Suspended (mg/l)	Solids Non-Filterable Volatile (mg/l)
CO-5	Max.	28	7.4	7.2	10	1.1	22.4	5	21	8
Conecuh River	Min.	26	7.1	6.7	10	0.5	4.0	2	2	0
at Ala. Hwy 41 near Brewton	Mean	27	7.2	6.9	10	0.8	12.2	4	8	3
CO-6	Max.	30	7.4	7.2	10	1.3	18.3	10	26	8
Conecuh River	Min.	25	6.8	6.5	10	0.7	6.2	4	2	0
at Pollard boat landing	Mean	28	6.9	7.0	10	1.0	13.9	6	11	2
M-11										
Murder Creek	Max.	26	8.4	7.1	15	1.3	23.2	9	14	4
at CCA's	Min.	23	7.3	5.3	10	0.3	5.7	3	1	0
water intake	Mean	25	7.7	6.7	11	0.8	13.7	6	7	2
LE-7	Max.	25	8.6	7.0	20	1.1	15.4	6	14	8
Little	Min.	22	8.1	5.4	10	0.4	6.6	2	2	0
Escambia Creek at U. S. Hwy 31 near Pollard	Mean	24	8.4	6.3	12	0.7	13.0	5	6	2
BE-8	Max.	26	7.5	7.0	10	3.0	19.1	11	12	6
Big Escambia	Min.	24	6.6	5.6	10	0.3	6.7	3	1	0
Creek at County road near Century, Fla.	Mean	25	7.0	6.3	10	1.6	12.2	5	6	2
E-9	Max.	28	7.3	7.2	10	4.0	21.6	8	36	5
Escambia River	Min.	26	6.8	6.5	10	0.6	9.6	5	4	1
at Fla. Hwy 4 near Century	Mean	28	7.1	6.9	10	1.9	15.7	6	14	3
FM-10	Max.	28	8.5	7.3	10	1.3	16.4	6	27	9
Franklin Mill	Min.	21	7.4	5.5	10	0.3	4.1	3	1	0
Creek at U.S. Hwy. 31 near Brewton	Mean	23	8.0	6.3	10	0.8	10.5	4	8	3

Creek receives both treated and untreated wastes, BOD_5 concentrations were similar to those observed in Little Escambia Creek, which does not have any known point sources of organic waste discharges. The average BOD_5 in Murder Creek was 0.8 mg/l and the BOD_5 ranged from 1.3 to 0.3 mg/l. Average BOD_5 in Big Escambia Creek, which receives effluent from the waste stabilization pond at Flomaton, was 1.6 mg/l with ranges from 3.0 to 0.3 mg/l. Table V contains a summary of water quality data from the Conecuh-Escambia River system and Appendix E contains a list of all data.

FIGURE 1


TENNESSEE
ALABAMA
GEORGIA
MISSISSIPPI
FLORIDA
VICINITY MAP
STUDY AREA
Brewton
East Brewton
FM-10
RIVER
CO-5
Florala
Florala
ALABAMA
FLORIDA
ESCAMBIA
SANTA ROSA CO
CO-6
BC-6
E-9.5
ESCAMBIA
RIVER
INSERT
N
SCALE IN MILES
SOUTHEAST WATER LABORATORY
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APPENDIX A

ACKNOWLEDGEMENT

The cooperation and resources extended by Container Corporation to EPA are a fine example of productive government-industry relations. Thanks is expressed to their quick responding electrical crews for immediate hookup and disconnection of our mobile lab; the ever watchful eye of CCA's security force; Technical Section personnel who worked with EPA people seven days a week: John Fay, Technical Superintendent; William Brantley, Project Engineer; Rudy Yuhasz, Shift Supervisor; Larry Croft, Technician; Hilton Howard, Technician; the remaining members of the section, and mill management for their effort in producing a very successful field study.

EPA Field Personnel were:

Dennis Cafaro - Sanitary Engineer

Steve Hall - Sanitary Engineer

Pat Lawless - Chemist

Ray Wilkerson - Hydraulic Technician

Chuck Holland - Co-op Student

APPENDIX B

SAMPLING PROCEDURE AND ANALYTICAL METHODOLOGY

SAMPLING PROCEDURE

Samples were collected for 10 days from 8 in-plant sampling sites and 7 stream sampling locations. Container Corporation personnel assisted in sample collection and all samples were split with the company.

Twenty-four hour composite samples were collected at one hour intervals at all in-plant sampling stations. Parameters analyzed included temperature, pH, color, and BOD_5. Samples to be analyzed for filterable and non-filterable solids, PCB's, COD, and TOC were preserved, if necessary, and returned to the Southeast Water Laboratory at Athens, Georgia for analysis.

All stream samples were collected by the grab sample method once per day, except during the first week when samples from sampling stations E-9 and CO-7 were sampled twice daily. Stream samples were routinely analysed for DO, pH, temperature, color, BOD_5, COD, TOC and filterable and non-filterable solids. All samples were collected at mid-depth since the stream depths were less than 10 feet. Two collection techniques were employed-- DO can sampler and an open bucket. Dissolved oxygen samples were immediately carried to the second step of fixation (addition of alkaline azide) and placed on ice. The remaining sample was poured into two 2-liter containers, placed on ice and at the end of the sample run returned to the mobile laboratory for processing.

ANALYTICAL METHODOLOGY

The following analytical methods were used by EPA personnel:

- pH -- laboratory instrument meter

- Dissolved Oxygen -- modified Winkler with full-bottle technique -- "FWPCA Methods for Chemical Analysis of Water and Wastes," November 1969.

- Total Organic Carbon (TOC) -- single channel instrument, DOW Beckman Carbonaceous Analyzer," FWPCA Methods for Chemical Analysis of Water and Wastes," November 1969.

- Five-Day Biochemical Oxygen Demand (BOD) -- "FWPCA Methods for Chemical Analysis of Water and Wastes," November 1969. (Using only Conecuh River water at Station CO-5 for dilution of in-plant samples.)

- Chemical Oxygen Demand(COD) -- Dichromate Reflux -- 0.25 N; Standard Methods for the Examination of Water and Wastewater, 12th Edition.

- COD -- Dichromate Reflux -- 0.025 N, "FWPCA Methods for Chemical Analysis of Water and Wastes," November 1969.

- Color -- Platinum-Cobalt visual, "FWPCA Methods for Chemical Analysis of Water and Wastes," November 1969.

- Solids -- Total suspended solids (non-filterable residue), "FWPCA Methods for Chemical Analysis of Water and Wastes," November 1969, Total volatile suspended solids (filterable residue), "Standard Methods for the Examination of Water and Wastewater," 12th Edition.

- Polychlorinated Biphenyl's (PCB) -- Gas chromatography using the electron capture detect.

Preservation methods for samples sent back to Southeast Water Laboratory:

PCB - None

Solids - None

TOC - 1 ml of 10% H_2SO_4 per 100 ml of sample

COD - Same as TOC.

APPENDIX C

DYE STUDY PROCEDURES

Dye studies were performed June 19-23. Dupont Rhodamine W. T. 20 dye was used for all injections and concentrations were measured by an American Instrument Company Fluorometer. Some samples were collected manually, but the bulk of collection was with Serco automatic samplers -- collecting at 1-hour intervals.

Three in-plant areas were investigated for time of travel:

1. Minimum retention times in the aeration basin and oxidation pond -- 14 gallons of dye were dumped prior to the oxygen injection nozzle at the clarifier outlet. Visual inspection of the dye was first made at the aeration basin inlet pipe. The dye was then visually followed as long as possible through the aeration basin. Samples were collected at the aeration basin and oxidation pond outlets using Serco samplers.
2. Bleach plant waste travel from the sewer line discharge (CC-7) to the spillway (CC-3) -- 1 gallon of dye was dumped and sample collection was made with a Serco sampler.
3. Time of travel from the spillway to Brewton Lake discharge (CC-4) -- three dye dumps were made: 3 gallons at the spillway; 2 gallons at the inlet to Jackson Lake; and 2 gallons at bridge above Merritt Lake. Samples were collected with Serco samplers.

APPENDIX D

Appendix D

Water Quality Data
Container Corporation and Conecuh-Escambia River Basin
(June-July 1971)

Station	Date	pH	Color Pt.Co.	Temp.* °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
CC-1	6/20-21	9.5	125	43	104	695	145	168	102	26.7
CC-1	6/21-22	8.3	200	44.5	119	726	190	344	156	26.7
CC-1	6/22-23	9.7	200	44.5	140	658	165	172	108	26.7
CC-1	6/23-24	7.8	240	43.5	107	547	125	232	192	26.7
CC-1	6/24-25	9.4	700	40.5	270	2,671	400	684	298	26.7
CC-1	6/27-28	8.5	600	43	80	1,616	260	316	252	26.7
CC-1	6/28-29	7.3	500	44	103	929	150	176	156	26.7
CC-1	6/29-30	--	400	45	101	675	175	248	212	26.7
CC-1	6/30-7/1	8.0	450	45	125	719	165	240	108	26.7
CC-1	7/1-2	9.1	500	44	162	1,421	275	612	452	26.7
Max.		9.7	700	45	270	2,671	400	684	452	26.7
Min.		7.3	125	40.5	80	547	125	168	102	26.7
Mean		8.6	392	43.7	131	1,066	205	319	204	26.7
CC-2	6/20-21	7.5	120	29.5	11	148	37	60	23	21.7
CC-2	6/21-22	7.9	120	29	11	130	38	25	8	21.7
CC-2	6/22-23	7.8	120	26.5	10	130	37	29	14	21.7
CC-2	6/23-24	8.3	120	28.5	8	125	43	20	10	21.7
CC-2	6/24-25	8.5	200	29.5	13	107	33	10	6	21.7
CC-2	6/27-28	7.4	150	29	10	122	34	18	14	25.0
CC-2	6/28-29	5.4	150	29.5	9	114	37	78	4	25.0
CC-2	6/29-30		200	29	10	147	46	56	4	25.0
CC-2	6/30-7/1	7.5	200	28.5	12	134	44	104	10	25.0
CC-2	7/1-2	7.0	200	27	10	132	49	60	8	25.0
Max.		8.5	200	29.5	13	148	49	104	23	25.0
Min.		5.4	120	26.5	8	107	33	10	4	21.7
Mean		7.4	158	28.6	10.4	129	40	46	10	21.7

* Temperatures are instantaneous.

Appendix D - Continued

Station	Date	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
CC-3	6/20-21	6.0	200	29.5	30	199	62	41	14	51.0
CC-3	6/21-22	6.7	200	32	26	205	69	50	15	51.0
CC-3	6/22-23	6.4	200	28.5	30	203	50	42	17	51.0
CC-3	6/23-24	6.3	240	30.5	30	214	67	44	14	51.0
CC-3	6/24-25	6.3	600	30.5	45	143	60	32	22	51.0
CC-3	6/27-28	6.1	350	31	24	170	54	44	28	54.2
CC-3	6/28-29	6.0	300	31	28	197	58	22	6	54.2
CC-3	6/29-30		300	31.5	28	203	77	28	4	54.2
CC-3	6/30-7/1	6.6	300	31.5	40	227	72	16	4	54.2
CC-3	7/1-2	6.5	300	30.5	33	218	67	68	24	54.2
Max.		6.7	600	32	45	227	77	68	28	54.2
Min.		6.0	200	28.5	24	143	50	16	4	51.0
Mean.		6.3	299	30.6	31.4	198	64	39	15	52.6
CC-4	6/20-21	7.3	200	28	8	152	50	27	10	56.4
CC-4	6/21-22	7.4	200		5	130	48	24	6	56.4
CC-4	6/22-23	7.5	250	19.5	7	60	49	17	11	56.4
CC-4	6/23-24	7.3	250	23.5	9	146	56	16	13	56.4
CC-4	6/24-25	7.4	600	24.5	9	142	48	6	4	56.4
CC-4	6/27-28	7.1	400	26	5	140	48	16	6	56.4
CC-4	6/28-29		350	25.5	5	143	49	14	10	56.4
CC-4			400	26	8	134	57	12	8	56.4
CC-4	6/30-7/1	7.0	300	23.5	10	125	44	16	6	56.4
CC-4	7/1-2	7.0	300		7	143	51	16	14	56.4
Max.		7.5	600	28	10	152	57	27	14	56.4
Min.		7.0	200	19.5	5	60	44	6	4	56.4
Mean		7.2	325	24.6	7.3	132	50	16	9	56.4

Appendix D-Continued

Station	Date	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
CC-5	6/20-21	9	140	43	94	304	60	50	29	26.7
CC-5	6/21-22	8.7	150	43.5	83	368	90	126	42	26.7
CC-5	6/22-23	9.4	170	43.5	100	386	78	88	56	26.7
CC-5	6/23-24	8.7	200	44	96	297	77	36	32	26.7
CC-5	6/24-25	9.4	600	39.5	124	467	120	88	60	26.7
CC-5	6/27-28	8.7	500	43	62	330	80	84	48	26.7
CC-5	6/28-29	7.1	400	44	90	431	97	92	48	26.7
CC-5	6/29-30		400	44	82	347	99	88	48	26.7
CC-5	6/30-7/1	7.7	400	44	124	365	110	72	40	26.7
CC-5	7/1-2	8.4	450	43.5	130	507	165	160	88	26.7
Max.		9.4	600	44	130	507	165	160	88	26.7
Min.		7.1	140	39.5	62	297	60	36	29	26.7
Mean		8.6	341	43.2	98.5	380	98	88	49	26.7
CC-6	6/21	7.6	120	34	--**	156	45	11	2	25.9
CC-6	6/21-22	7.5	120	33.5	--**	130	50	20	6	25.9
CC-6	6/22-23	7.5	120	33	--**	156	49	65	37	25.9
CC-6	6/23-24	7.4	160	34	28	145	55	44	25	25.9
CC-6	6/24-25	7.3	200	35	31	134	44	24	22	25.9
CC-6	6/27-28	7.2	200	35.5	29	224	69	38	34	25.9
CC-6	6/28-29	6.4	200	36	25	233	66	18	12	25.9
CC-6	6/29-30		200	35.5	19	221	79	8	4	25.9
CC-6	6/30-7/1	7.4	200	35.5	18	204	70	28	14	25.9
CC-6	7/1-7/2	7.0	200	35.5	17	202	73	40	14	25.9
Max.		7.6	200	36	31	233	79	65	37	25.9
Min.		6.4	120	33	17	130	44	8	2	25.9
Mean		7.2	172	35	23.8	180	60	30	17	25.9
CC-7	6/20-21	3.3	500	42	60	412	145	54	42	23.7
CC-7	6/21-22	3.0	500	43	84	435	220	52	42	23.7
CC-7	6/22-23	3.0	500	43.5	80	356	150	24	20	23.7

** Dilutions set too high -- data not valid.

Appendix D-Continued

Station	Date	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
CC-7	6/23-24	2.9	500	43.5	74	374	185	14	10	23.7
CC-7	6/24-25	3.1	500	41.5	77	324	125	32	30	23.7
CC-7	6/27-28	3.8	400	43	34	212	75	10	8	23.7
CC-7	6/28-29	3.4	500	44	58	400	155	8	4	23.7
CC-7	6/29-30		500	44.5	70	370	160	20	2	23.7
CC-7	6/30-7/1	3.4	500	45.5	78	425	180	14	6	23.7
CC-7	7/1-2	3.0	600	44.5	71	385	160	30	20	23.7
Max.		3.8	600	45.5	84	435	220	54	42	23.7
Min.		2.9	400	41.5	34	212	75	8	2	23.7
Mean		3.2	500	43.5	68.6	369	156	26	18	23.7
CC-8	6/20-21	7.0	300	29.5	30	292	52	812	242	3.1
CC-8	6/21-22	7.0	200	27	42	246	61	548	120	3.1
CC-8	6/22-23	7.5	200	29.5	33	192	32	360	104	3.1
CC-8	6/23-24	7.2	260	26.5	39	329	77	504	236	3.1
CC-8	6/24-25	7.3	400	29	43	314	60	772	180	3.1
CC-8	6/27-28	6.5	350	32	24	279	45	704	188	3.1
CC-8	6/28-29	5.7	300	30.5	38	265	50	348	72	3.1
CC-8	6/29-30		300	31	42	459	120	196	176	3.1
CC-8	6/30-7/1	6.4	300	30	38	360	85	648	128	3.1
CC-8	7/1-2	6.5	300	28.5	44	526	110	884	248	3.1
Max.		7.3	400	32	44	526	120	884	248	3.1
Min.		5.7	200	26.5	24	192	32	196	72	3.1
Mean		6.8	291	29.4	37.3	326	69	578	169	3.1

Appendix D - Continued

Station	Date	Time	DO mg/l	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
CO-5	6/21	0830	7.3	6.7	10	26	0.6	22.4	5	21	0	
CO-5	6/22	0818	7.2	7.1	10	26.5	0.7	13.2	4	6	1	
CO-5	6/23	0840	7.3	7.1	10	26	0.9	13.2	4	10	2	
CO-5	6/24	0820	7.3	7.1	10	27	0.9	4.0	5	6	1	
CO-5	6/25	0830	7.1	6.9	10	28	1.1	13.7	3	12	8	
CO-5	6/28	0836	7.4	6.7	10	28	0.5	10.4	2	2	1	
CO-5	6/29	0834	7.2	7.2	10	28	0.6	9.7	4	4	2	
CO-5	6/30	0914	7.1		10	28	0.9	9.7	5	8	2	
CO-5	7/1	0820	7.2	7.0	10	28	0.9	12.8	5	5	4	
CO-5	7/2	1020	7.1	6.7	10	27	1.1	13.9	5	8	4	
Max.			7.4	7.2	10	28	1.1	22.4	5	21	8	
Min.			7.1	6.7	10	26	0.5	4.0	2	2	0	
Mean			7.2	6.9	10	27.2	0.8	12.2	4	8	3	
CO-6	6/21	1055	6.9	6.5	10	25	1.0	14.5	7	22	1	
CO-6	6/21	1430	7.2	7.0		27	1.1	18.2	7			
CO-6	6/22	1000	6.9	6.9	10	27	0.7	17.1	7	26	8	
CO-6	6/22	1500	6.9	7.2		28	1.3	17.2	7			
CO-6	6/23	1095	7.0	7.1	10	26.5	0.9	15.8	6	2	1	
CO-6	6/23	1400	7.4	7.2		28	1.3	16.5	5			
CO-6	6/24	1126	6.9	7.0	10	28	0.8	6.2	6	11	2	
CO-6	6/24	1455	7.0	6.9		29	1.1	6.2	6			
CO-6	6/25	1130	7.1	7.0	10	29	1.1	11.9	5	7	2	
CO-6	6/25	1400	7.1	7.1		30	1.0	10.2	10			
CO-6	6/28	1055	6.8	6.7	10	28	0.9	14.9	4	8	2	
CO-6	6/29	1100	6.9		10	29	1.2	11.9	6	4	2	
CO-6	6/30	1130	7.0		10	28	0.9	13.1	7	13	0	
CO-6	7/1	1315	7.2	6.7	10	29	1.3	16.2	6	6	3	
CO-6	7/2	1020	6.9	7.1	10	27	1.1	18.3	7	15	3	
Max.			7.4	7.2	10	20	1.3	18.3	10	26	8	
Min.			6.8	6.5	10	25	0.7	6.2	4	2	0	
Mean			6.9	7.0	10	27.9	1.0	13.9	6	11	2	

Appendix D - Continued

Station	Date	Time	DO mg/l	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
LE-7	6/21	1024	8.2	5.4	20	23	0.9	14.7	6	3	0	
LE-7	6/22	0945	8.3	6.1	20	23	0.4	12.8	5	11	3	
LE-7	6/23	1022	8.4	6.2	10	22.5	0.7	13.8	6	14	8	
LE-7	6/24	1100	8.1	5.9	10	23.5	0.4	14.8	5	2	0	
LE-7	6/25	1020	8.1	6.6	10	24	1.1	6.6	4	6	2	
LE-7	6/28	0940	8.5	5.9	10	24	0.8	15.4	2	6	2	
LE-7	6/29	0930	8.5		10	24	0.6	11.8	5	3	2	
LE-7	6/30	1010	8.5		10	23	0.8	14.2	5	7	2	
LE-7	7/1	1200	8.6	7.0	10	25	1.1	12.8	4	3	1	
LE-7	7/2	0921	8.5	7.0	10	24	0.4	13.6	6	6	2	
Max.			8.6	7.0	20	25	1.1	15.4	6	14	8	
Min.			8.1	5.4	10	22.5	0.4	6.4	2	2	0	
Mean			8.4	6.3	12	23.6	0.7	13.0	5	6	2	
BE-8	6/21	1010	6.9	5.6	10	24.5	0.3	12.9	5	12	0	
BE-8	6/22	0930	6.9	6.0	10	25	0.7	13.2	5	8	1	
BE-8	6/23	1005	7.1	6.5	10	24.5	2.7	15.0	5	6	1	
BE-8	6/24	1042	7.1	6.0	10	25.5	1.3	6.7	5	1	0	
BE-8	6/25	0920	6.9	6.2	10	26	1.0	9.0	5	8	6	
BE-8	6/28	0955	7.4	6.1	10	26	0.5	9.9	3	3	1	
BE-8	6/29	0944	6.6		10	26	2.6	15.7	6	3	1	
BE-8	6/30	1025	7.1		10	25	1.4	10.9	5	5	3	
BE-8	7/1	1215	7.5	7.0	10	26	3.0	10.1	4	4	2	
BE-8	7/2	0930	6.7	7.0	10	25	2.7	19.1	11	12	3	
Max.			7.5	7.0	10	26	3.0	19.1	11	12	6	
Min.			6.6	5.6	10	24.5	0.3	6.7	3	1	0	
Mean			7.0	6.3	10	25.4	1.6	12.2	5	6	2	
E-9	6/21	0955	7.1	6.5	10	25.5	0.6	16.1	6	20	2	
E-9	6/21	1400	7.3	7.1		26.5	0.7	14.6	6			

Appendix D - Continued

Station	Date	Time	DO mg/l	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOC mg/l	TSS mg/l	TVSS mg/l	Flow cfs
E-9	6/22	0920	6.8	6.8	10	27	4.0	17.32	6	36	3	
E-9	6/22	1430	7.3	7.2		28	2.2	20.0	7			
E-9	6/23	0945	7.1	7.0	10	26	2.4	17.6	6	12	1	
E-9	6/23	1315	7.1	7.1		27	1.7	14.5	5			
E-9	6/24	1025	6.9	6.9	10	27	1.4	10.9	6	10	1	
E-9	6/24	1425	7.1	6.9		29	2.3	9.8	7			
E-9	6/25	0943	7.3	6.8	10	28	1.4	9.6	5	6	3	
E-9	6/25	1325	7.0	6.9		29	2.3	18.0	8			
E-9	6/28	1015	7.1	6.6	10	28	2.5	21.6	5	14	4	
E-9	6/29	1010	7.0		10	29	0.9	13.9	6	4	2	
E-9	6/30	1045	7.0		10	29	0.7	13.6	5	18	5	
E-9	7/1	1230	7.2	6.7	10	29	3.2	19.6	7	5	3	
E-9	7/2	0945	7.1	6.9	10	27	1.6	18.0	7	18	4	
Max.			7.3	7.2	10	29.0	4.0	21.6	8	36	5	
Min.			6.8	6.5	10	25.5	0.6	9.6	5	4	1	
Mean			7.1	6.9	10	27.7	1.9	15.7	6	14	3	
FM-10	6/21	0905	8.5	5.5	10	21.5	0.7	11.8	4	8	1	2.4
FM-10	6/22	0800	8.0	6.5	10	22	0.4	16.4	4	27	1	2.4
FM-10	6/23	0820	8.2	6.0	10	21	0.9	12.2	5	1	0	2.4
FM-10	6/24	0800	8.2	6.1	10	21	0.7	4.2	5	7	6	2.4
FM-10	6/25	0800	7.4	6.1	10	24.5	1.3	6.2	4	9	6	2.4
FM-10	6/28	0815	8.1	5.9	10	23	.8	5.2	3	4	0	2.4
FM-10	6/29	0810	7.6	6.3	10	23	1.2	14.8	6	12	9	2.4
FM-10	6/30	0850	8.1		10	24	0.3	8.7	4	2	2	2.4
FM-10	7/1	1345	7.6	6.7	10	28	0.9	12.5	5	8	5	2.4
FM-10	7/2	0800	8.0	7.3	10	22	0.6	12.9	5	4	2	2.4
Max.			8.5	7.3	10	28	1.3	16.4	6	27	9	2.4
Min.			7.4	5.5	10	21	0.3	4.2	3	1	0	2.4
Mean			8.0	6.3	10	23	0.8	10.5	4.5	8	3	2.4
Mean lbs/day							10	140	60	107	40	

Appendix D - Continued

Station	Date	Time	DO mg/l	pH	Color Pt.Co.	Temp. °C	BOD mg/l	COD mg/l	TOCq mg/l	TSS mg/l	TVSS mg/l	Flow cfs
M-11	6/21	0925	8.4	7.1	15	24	1.1	18.1	7	13	0	
M-11	6/22	0930	7.6	7.0	15	24	.3	12.9	6	9	0	
M-11	6/23	0920	7.7	6.9	10	23	1.1	15.0	6	1	1	
M-11	6/24	0915	7.5	7.0	10	24	0.5	5.7	5	4	2	
M-11	6/25	0915	7.3	6.8	10	25	0.6	7.8	4	4	4	
M-11	6/28	0900	7.5	6.3	10	25.5	0.6	10.9	3	5	1	
M-11	6/29	0910	7.7	5.3	10	25.5	0.7	11.6	5	9	4	
M-11	6/30	0835	7.6		10	25	0.5	13.5	6	8	4	
M-11	7/1	1330	7.8	7.1	10	26.5	0.8	18.7	7	7	2	
M-11	7/2	0900	7.7	6.6	10	24	1.3	23.2	9	14	2	
Max.			8.4	7.1	15	26.5	1.3	23.2	9	14	4	
Min.			7.3	5.3	10	23	0.3	5.7	3	1	0	
Mean			7.7	6.7	11	24.6	0.8	13.7	6	7	2	